PRICE $1.00

# Assembling and Using Your... Heathkit

## DECADE RESISTANCE

MODEL DR-1

**HEATH COMPANY**

*A Subsidiary of Daystrom Inc.*

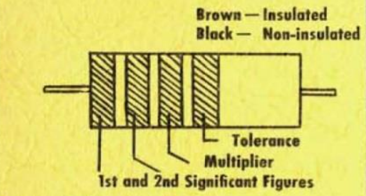
**BENTON HARBOR, MICHIGAN**

595-19

# STANDARD COLOR CODE — RESISTORS AND CAPACITORS

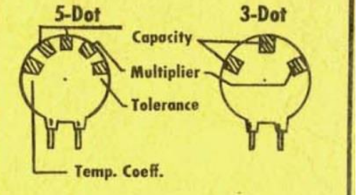
| INSULATED<br>UNINSULATED<br>Color | FIRST RING<br>BODY COLOR<br>First Figure | SECOND RING<br>END COLOR<br>Second Figure | THIRD RING<br>DOT COLOR<br>Multiplier |
|---|---|---|---|
| BLACK | 0 | 0 | None |
| BROWN | 1 | 1 | 0 |
| RED | 2 | 2 | 00 |
| ORANGE | 3 | 3 | ,000 |
| YELLOW | 4 | 4 | 0,000 |
| GREEN | 5 | 5 | 00,000 |
| BLUE | 6 | 6 | 000,000 |
| VIOLET | 7 | 7 | 0,000,000 |
| GRAY | 8 | 8 | 00,000,000 |
| WHITE | 9 | 9 | 000,000,000 |

### AXIAL LEAD RESISTOR

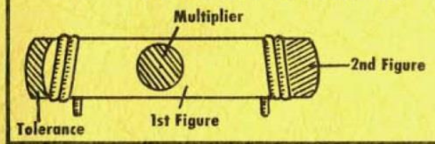


Wire wound resistors have 1st digit band double width

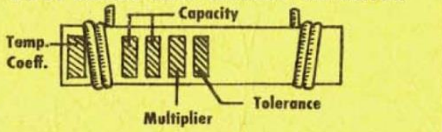
### DISC CERAMIC RMA CODE



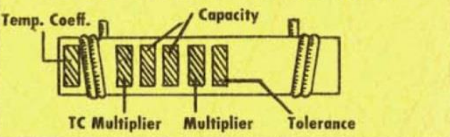
### RADIAL LEAD DOT RESISTOR



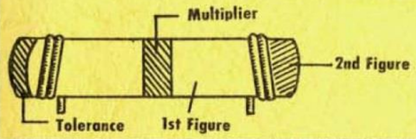
### 5-DOT RADIAL LEAD CERAMIC CAPACITOR



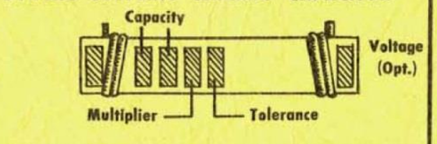
### EXTENDED RANGE TC CERAMIC HICAP



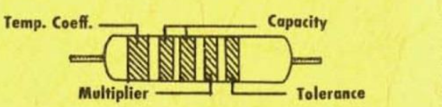
### RADIAL LEAD (BAND) RESISTOR



### BY-PASS COUPLING CERAMIC CAPACITOR



### AXIAL LEAD CERAMIC CAPACITOR

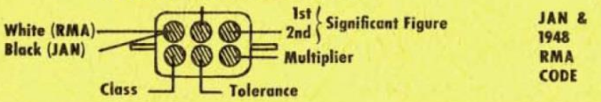


The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

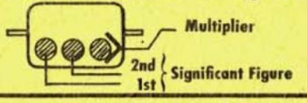
The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

## MOLDED MICA TYPE CAPACITORS

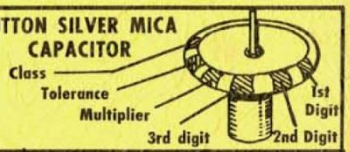
### CURRENT STANDARD CODE



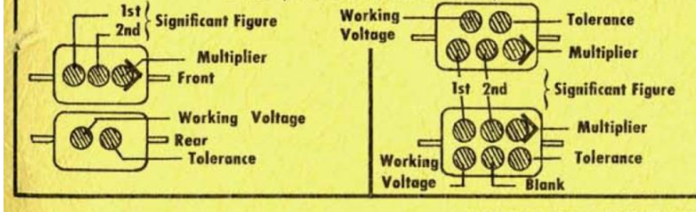
### RMA 3-DOT (OBSOLETE) RATED 500 W.V.D.C. ± 20% TOL.



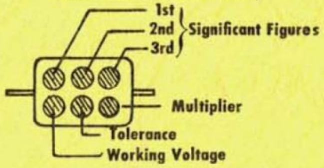
### BUTTON SILVER MICA CAPACITOR



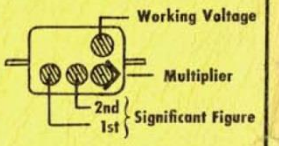
### RMA (5-DOT OBSOLETE CODE)



### RMA 6-DOT (OBSOLETE)

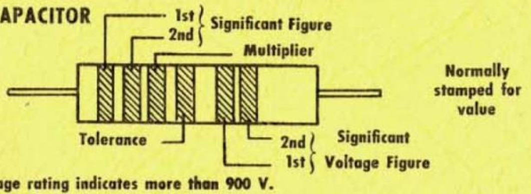


### RMA 4-DOT (OBSOLETE)



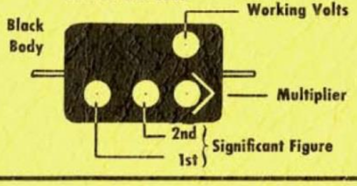
## MOLDED PAPER TYPE CAPACITORS

### TUBULAR CAPACITOR

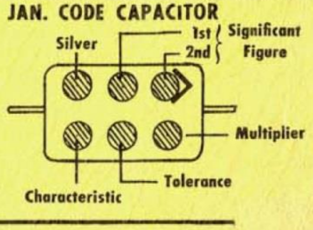


A 2 digit voltage rating indicates more than 900 V. Add 2 zeros to end of 2 digit number.

### MOLDED FLAT CAPACITOR



### JAN. CODE CAPACITOR



The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts

In the design of Heathkits, the temperature coefficient of c or mica capacitors is not generally a critical factor and fore Heathkit manuals avoid reference to temperature co cient specifications.

Courtesy of Centralab

# HEATHKIT

## MODEL DR-1

# DECADE RESISTANCE KIT

## SPECIFICATIONS

| | |
|---|---|
| *Range* | 1 Ω to 99,999 Ω in one ohm steps |
| *Components* | Resistors: Precision - 1/2% accuracy<br>Switches: Ceramic |
| *Maximum Current* | Units - - - - - - - - - - - 500 MA<br>Tens - - - - - - - - - - - 150 MA<br>Hundreds - - - - - - - - 50 MA<br>Thousands - - - - - - - 15 MA<br>Ten Thousands - - - - 5 MA |
| *Dimensions* | 14 1/2" x 3 3/8" Birch Cabinet |

# ASSEMBLY AND USE OF THE HEATHKIT
# MODEL DR-1

## DECADE RESISTANCE KIT

This unit is designed as an accurate Laboratory type of instrument and construction should be made with this work mentality in mind. Take time to do a top notch job of assembly so that years of dependable service are assured. **READ THIS MANUAL THOROUGHLY AND COMPLETELY BEFORE ASSEMBLY**

Check all parts against the parts list so that no components are inadvertently thrown away with The packaging.

Read the note on soldering on the inside of back cover. **Make** a good mechanical joint with Clean metal to clean metal at each connection. **USE ONLY GOOD** QUALITY ROSIN CORE RADIO SOLDER. Soldering pastes or acids are difficult to remove and minute amounts remaining tend to combine with moisture from the air to form a corrosive product which will ultimately result in failure of the instrument.

**NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED WHEN IN DOUBT ABOUT SOLDER. IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.**

Small changes in parts may be made by the Heath Company. All parts supplied will work just As well as the part for which it is substituted. All substitutions will be of equal or better Quality than the original and will be made if necessary in order that a minimum delay will occur when filling your order.

## STEP BY STEP ASSEMBLY

**Please refer to wiring pictorials for best wire location.**

**(S) means solder the connection** **(NS) means do not solder yet**

**SWITCHES - - All the switches in this decade resistance are identical and should be basically exactly alike. The "unit" switch will use the 1 Ω, 2 Ω, 3 Ω, and 6 Ω resistors. The "tens" switch will contain the 10 Ω, 20 Ω, 30 Ω, and 60 Ω resistors; the "hundreds" switch uses 100Ω , 200 Ω, 300 Ω and 600 Ω resistors. The 1 KΩ, 2 kΩ, 30 kΩ, and 60k Ω resistors are on the "ten thousands" switch.**

Diagram No 1. Note that the switch connections are numbered clockwise and that the number is followed by the letter "R" or "F" which signify either the rear or front section of each. In wiring keep the switch oriented exactly in the position shown on this drawing.

Terminal lugs on the switch are not shown in the diagrams. These extra lugs serve only to position the rotor.

## “UNITS SWITCH”

( ) Commence wiring a switch by connecting one end of the 1 Ω resistor to switch lug #3R (S) and the other side end at this resistor to the lug #1R ( NS) One end of 3 Ω resistor to Lug #2R (NS) and then straight over to Lug #1R (S). The other end of the 3 Ω resistor to Lug #1R (NS)

( ) A length of bare wire to Lug #1R (S) and diagonally across between the front and rear connections of the switch to Lug #5R (S).

( ) Fasten one end 2 Ω resistor to switch Lug #2R (S) and the other end to Lug #3R (NS) and then straight over to Lug #2R (S).

( ) The 1 Ω resistor connects to Switch Lug #1R (S) and the other end to Lug #4R (NS). and then directly over to switch Lug #R (S).

( ) A length of busbar from switch Lug #1R (S) and straight up to Lug #4R (S). This completes basic wiring of the "unites" switch.

As pointed put previously, the other switches are wired exactly as outlined. Out taking into account that the actual resistor values are multiples of the resistances on the "units" switch. However, for those who desire to follow precise step by step instructions, the following outlines detailed instructions for every switch.

## "TENS SWITCH"

( ) Start wiring the "tens" switch by connecting one end of the 60 Ω resistor to switch Lug #5R (S) and the other end of this resistor to Lug #1R (NS) one end of 30 Ω resistor to Lug #2R (NS) and then straight over to Lug #1R (S). The other end of the resistor to Lug #1F.

( ) A length of busbar to Lug #1F (S) and diagonally across between the front and rear sections of the switch to Lug #6R (S).

( ) Fasten one end of the 20 Ω resistor to switch Lug #3R (S) and the other end to Lug #2R (NS) and then directly over to switch Lug #2R (S).

( ) The 10 Ω resistor connects to switch Lug #3F (S) and the other end to Lug #4R (NS) and then directly over to switch lug #3R (S).

( ) A length of busbar from switch Lug #4F (S) and straight up to Lug #4R (S).

The "tens" switch has now been basically completed.

## "HUNDREDS SWITCH"

( ) Connect one end of the 600 Ω resistor to switch Lug #5R (S) and the other end of this resistor to Lug #1R (NS). One end of the 300 Ω resistor to Lug #2R (NS) and then straight over to Lug #1R (S). The other end of this 300 Ω resistor to Lug #1F (NS).

( ) A length of busbar to Lug #1F (S) and diagonally across between the front and rear section of the switch to lug #6R (S).

( ) Fasten one end of the 200 Ω resistor to switch Lug #2F (S) and the other end to Lug #3R (NS) and then straight over to Lug #2R (S).

( ) The 100 Ω resistor connects to switch Lug #3F (S) and the other end to Lug #4R (NS) and then directly over to switch Lug #3R (S).

( ) A length of busbar from switch Lug #4F (S) and straight up to Lug #4R (S). The 'hunreds" switch has been basically wired.

## "THOUSANDS SWITCH"

( ) Fasten one end of the 4k Ω resistor to switch Lug #3M and the other and the other end of this resistor to Lug #1R (NS). One end of the 3 K11 resistor to Lug #2H (NS) and then straight over to Lug #1M (S). The other end of this 3 K OHM resistor to Lug #1F (NS).

( ) A length of bare wire to Lug #1F (S) and diagonally across between the front and rear sections Of the switch to Lug # 1FR (S).

( ) Connect one end of the 3k OHM resistor to switch Lug #3F (S) and the other end to Lug #3R (NS) and then straight to Lug #2R (S).

( ) The 1 k Ω resistor connects to switch Lug #3F (S) and the other end to Lug #1R (NS) and then Directly over to switch Lug #3R (S).

( ) A length of bare wire from switch Lug #4F (S) and straight up to Lug #4R (S), The 'thousands" switch has now been basically wired.

## "TEN THOUSANDS SWITCH"

( ) The last switch is wired by connecting one end of the 60 KΩ resistor to switch Lug #5 (S) And the other end of this resistor to Lug #1R (NS). One end of the 30 KΩ to resistor Lug #2R (NS) and then straight over to Lug #1R (S). The other end of this 30 KΩ resistor to Lug #1F (NS).

( ) A length of bare wire to Lug #1F (S) and diagonally across between the front and rear sections Of the switch to Lug #1R (S).

( ) Fasten one end of the 20 kΩ resistor to switch Lug # 2F (S) and the other end to Lug #3R (NS) and then straight over to switch Lug #2R (S).

( ) The 19 kΩ resistor connects to switch Lug #3F (S) and the other end to Lug # 4R (NS) and then directly over to switch Lug #3R (S).

( ) A length of busbar from switch Lug #1F (S) and straight up to lug #4 (S). All five switches are ready for panel installation.

## FINAL CONSTRUCTION

The binding posts are mounted as shown in the drawing, with assembly coming through from the Front of the panel. A fiber washer, flat metal washer, solder lug, lockwasher, and nut go on in That order to hold the assembly to the panel.

Mount the switches, observing that the "ten thousands" switch goes next to the binding posts with The remaining switches fastened in sequential order so that the units switch mounts last in the Space farthest away from the binding posts. Note positioning of switches shown by the main Assembly diagram.

Start final wiring by connecting a length of busbar from binding post lug A (S) to the "ten thousand" switch Lug X (S). a short length of busbar from Lug Y on this same switch (S) to Luh X on the "thousands" switch (S).

Fasten basebar to Lug Y of the "thousands switch (S) and to Lug X of the "hundreds" switch (S). Another length of busbar to Lug Y of the "hundreds" witch (S) over to Lug X on the "tens"switch.

A short section of basebar from Lug Y of the "tens" switch (S) to the X Lug on the "units" switch. (S). Connect an insulated wire from Lug C on the "units" switch (S), along the panel to binding post (S). The construction of your Heathkit Decade Resistance has now been completed.

## IN CASE OF DIFFICULTY IN CONSTRUCTION

Recheck the wiring. Most causes of trouble result from a wrong connection. Often having a friend check the wiring will reveal mistakes inadvertently overlooked. Check the switches to make sure they all work properly and make proper contact in every position.

Make sure that extraneous resistance due to solder, parts, flux, dust, and moisture have not been introduced in the circuit, particularly at the switches. Check all the resistors and other wiring for proper solder connections. Make sure each resistor and its lead does not touch the adjacent resistor and its lead.

## CIRCUIT DESCRIPTION

Special switched which properly connect combination of precision resistors in series are used In the instrument. An analysis of the "units" switch, for example, would allow that in that Position the resistors are bypassed and the switch assembly selected in the "unit" select decade switch.

On position 1, the 1Ω resistor is switched in. The 2 Ω resistor is used in position 2 and the 3 Ω is connected in position 3. For position 4, the 3 Ω and the 1 Ω resistors are connected in Series while for position 5 the 2 Ω and the 3 Ω resistors are placed in series. The 6 Ω resistor Is used for position 6 and when the switch is in position 7, the 1 Ω and 6 Ω resistors are in series. Position 8 finds the 6 Ω and the 2 Ω resistor in series, while in position 9, the 6 Ω and 3 Ω resistors are connected in series.

## APPLICATIONS

1, Calibration of instruments

2. Selection of proper meter multipliers

3. Bridge measurements

4. Experimental determination of proper circuit constants

CAUTION: Observe current limitation as outlined on specification page. This makes the Lowest range decade switch in use (off of zero position) will determine maximum allowable current,

## REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper test result operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and apply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
B. Identify the type and model number of kit in which it is used.
C. Mention the order number and date of purchase.
D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the Original component until specifically requested to do so. Do not dismantle the component in Question as this will void the guarantee. If tubes are to be returned, pack them carefully to Prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement Policy does not cover the free replacement part that may have been broken or damaged Through carelessness on the part of the kit builder

## SERVICE

In events considered operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair for a service charge of $5.00 plus the cost of any additional material that may be required. THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned not repaired.

The Heath Company is willing to offer its full cooperation to assist you in obtaining the proper Operation of your equipment and therefore this factory repair service is available to you or you may contact our Technical Consultation Department by mail.

## SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted.

**ATTACH A TAG TO THE INSTRUMENT GIVING NAME, ADDRESS AND TROUBLE EXPERIENCED.**

Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides . DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

## SPECIFICATIONS

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

## WARRANTY

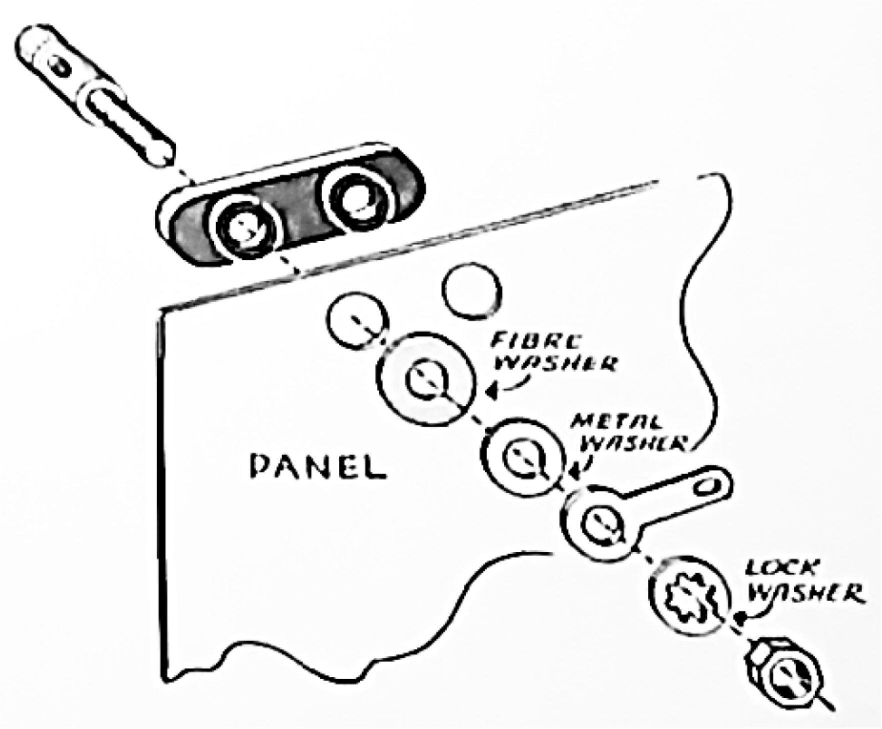
Heath Company warranties for a period of three months from the date of shipment all Heathkit products shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of work warranty, Heath Company shall apply only to the original purchase, and is and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or fulfillment on the part of Heath Company and in no event shall Heathkit Company be liable for any anticipated profits, consequential damages, loss of time or what being incurred by the buyer as generation with the purchase, assembly, or operation of Heathkits on your premise occurred. The replacement shall be made of parts damaged by the buyer in the event of building or assembling Heathkit equipment.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts that read is which acid core solder or paste fluxes have been used.

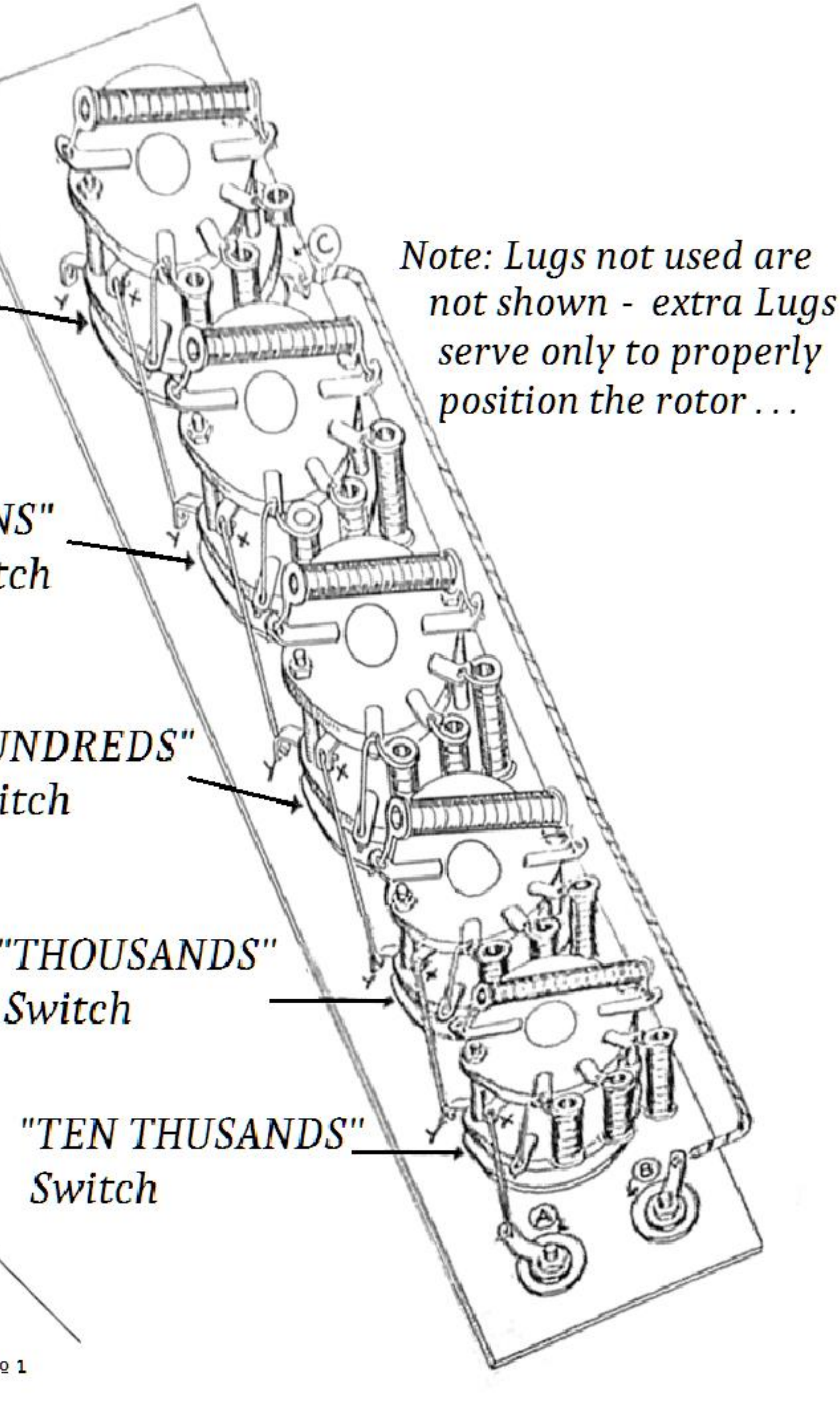
HEATH COMPANY

# DR-1 DECADE RESISTANCE

## PARTS LIST



| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| Precision Resistors | | |
| 2-1A | 1 | 1 Ω 1 watt |
| 2-2A | 1 | 2 Ω 1 watt |
| 2-3A | 1 | 3 Ω 1 watt |
| 2-1B | 1 | 6 Ω 1 watt |
| 2-4A | 1 | 10 Ω 1 watt |
| 2-5A | 1 | 20 Ω 1 watt |
| 2-6A | 1 | 30 Ω 1 watt |
| 2-2B | 1 | 60 Ω 2 watt |
| 2-7A | 1 | 100 Ω 1 watt |
| 2-8A | 1 | 200 Ω 1 watt |
| 3-9A | 1 | 300 Ω 1 watt |
| 2-3B | 1 | 600 Ω 2 watt |
| 2-10A | 1 | 1 KΩ 1 watt |
| 2-11A | 1 | 2 KΩ 1 watt |
| 2-12A | 1 | 3 KΩ 1 watt |
| 2-4B | 1 | 6 KΩ 2 watt |
| 2-13A | 1 | 10 KΩ 1 watt |
| 2-14A | 1 | 20 KΩ 1 watt |
| 2-15A | 1 | 30 KΩ 1 watt |
| 2-5B | 1 | 60 KΩ 2 watt |
| | | |
| Switches - Knobs | | |
| 63-22 | 5 | 10 position two deck rotary switch (with hardware) |
| 462-19 | 5 | Pointer knobs |
| | | |
| Terminal Parts-Hardware | | |
| 75-1 | 1 | Binding post insulator |
| 427-1 | 2 | Binding post base |
| 250-20 | 2 | Binding post thumbscrew |
| 252-5 | 2 | #10-32 nut |
| 254-3 | 2 | #10 lockwasher |
| 253-6 | 2 | Fiber washer |
| 253-8 | 2 | Nickel washer |
| 259-5 | 2 | #10 solder lug |
| 250-12 | 6 | #6 x 5/8 sheet metal screw |
| 253-10 | 5 | Control nickel washer |
| 252-7 | 5 | Control nut |
| 254-4 | 5 | Control lockwasher |
| 280-22 | 6 | Set screw |
| | | |
| Wire Panel Cabinet | | |
| 340-3 | 2 | 18 length busbar |
| 346-4 | 1 | Length spaghetti (sleeving) |
| 393-19 | 1 | Manual |



*Note: Lugs not used are not shown - extra Lugs serve only to properly position the rotor . . .*

*Note: Lugs not used are not shown - extra Lugs serve only to properly position the rotor . . .*

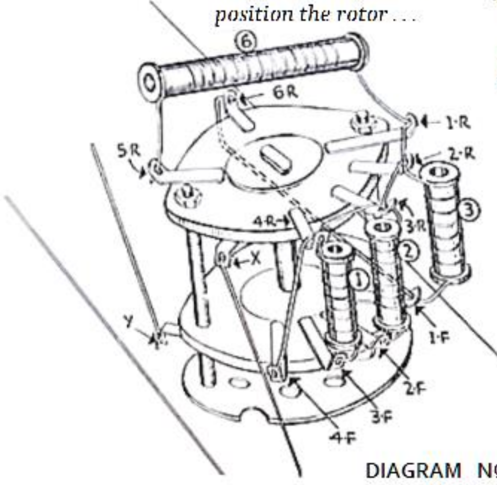


DIAGRAM № 1

# HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

## RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

## ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

## WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

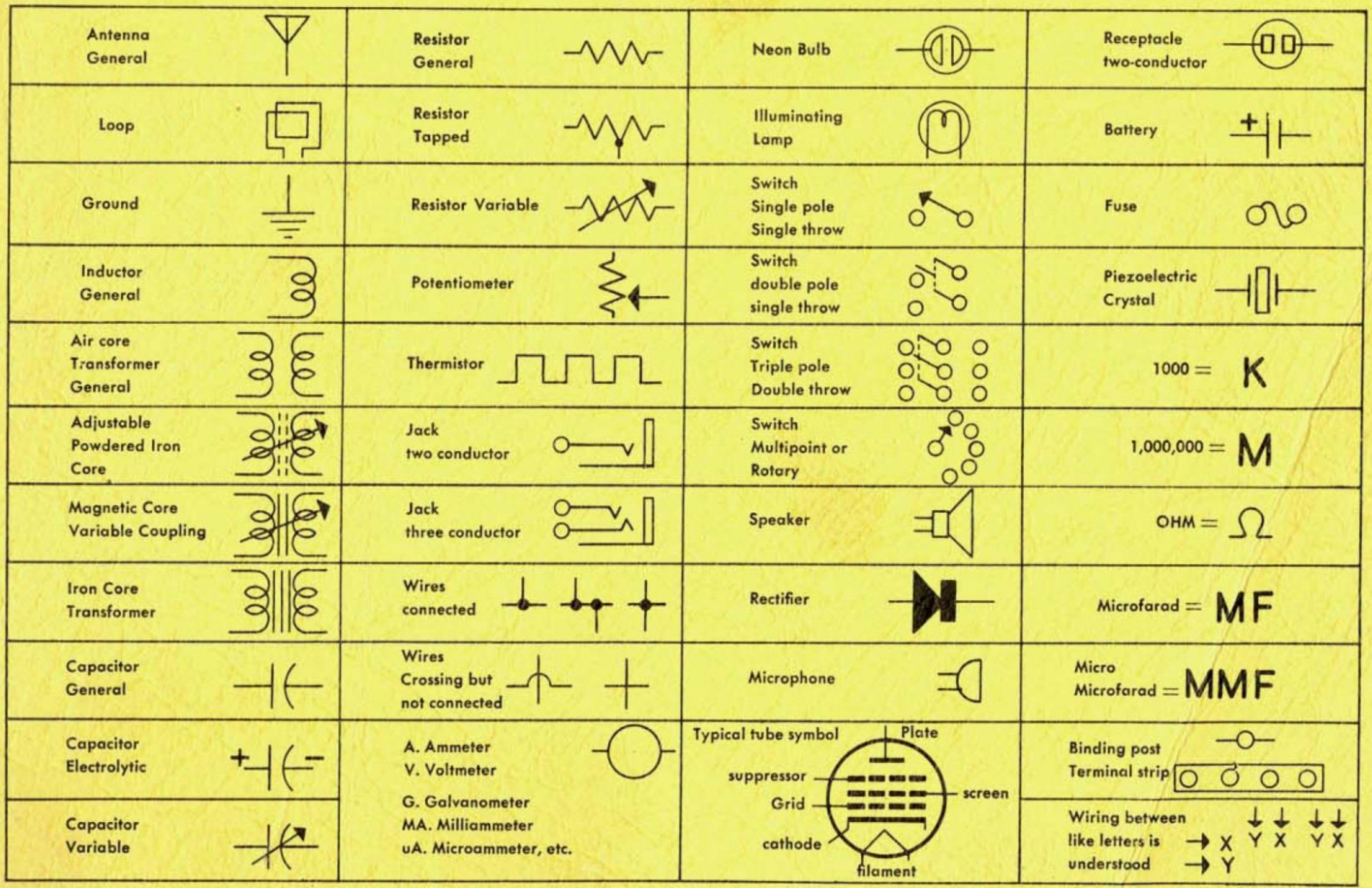
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

## SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.



Courtesy of I. R. E.